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DRAFT
Design Criteria Memorandum

Date:	November 3, 2011	Job No:	171578
To:	Randy Lee, U.S. Army Corps of Engineers	Project:	The Dalles East Fish Ladder Auxiliary Water Supply Engineering Design Report
From:	Ron Mason, P.E., Project Manager		
Copy:	file		
Re:	W9127N-11-D-0011, Task Order 0003, 20% submittal, DRAFT Design Criteria Memorandum		

This memorandum is being prepared for the USACE under contract no. W9127N-11-D-0011, Task Order 0003, The Dalles East Fish Ladder (EFL) Auxiliary Water System (AWS) Backup, Engineering Design Report (EDR)as part of the 20% contract submittal requirement. Information from this memorandum will be incorporated into the Design Criteria section included in the EDR being prepared for the project.

DESIGN CRITERIA

1.1 Purpose

The purpose of this memorandum is to set forth a detailed list of criteria used in the development of the EDR. The criteria are used to design system components, subjectively evaluate the four alternatives, and recommend the best alternative for further development by the USACE.

1.2 Background

The purpose of *The Dalles East Fish Ladder Auxiliary Water Backup System Engineering Design Report* is to recommend the alternative that will best provide a backup supply of water to the AWS. The AWS conduit supplies water to the East, West, and South Fish Ladder entrances in order to enhance attraction of upstream migrating adult fish. Water is currently supplied to the AWS conduit by two fish unit turbines located on the west end of the powerhouse. The AWS normally operates with a total flow of up to 5,000 cubic feet per second (cfs). If one or both fish unit turbines fail, water supplied to the AWS would be severely limited. Four (4) alternatives that could provide a backup supply of water to the AWS in case of a fish unit turbine failure have been selected for evaluation. The alternatives are as follows:

- Alternative #1, Siphon for Additional Water to the Fish Lock,
- Alternative #2, River Wet Tap,
- Alternative #10, Single Pump/Pumphouse on East Side of Cul-de-sac, and
- Alternative #11, Upstream Intake Tower with Siphon.

These 4 alternatives were selected by the USACE for further analysis from 15 alternatives/concepts formulated during a “brainstorming” session that was conducted in December, 2010. Other improvements to the existing infrastructure (fish lock and piping improvements) will also be examined during development of the EDR as potential sources of water for the AWS. The USACE and other agencies have agreed on a total flow requirement of 1,400 cfs for the AWS.

To ensure an equal treatment of each alternative in the EDR, a consistent set of assumptions, constraints, and design parameters are required to establish design criteria to be used in the alternative evaluation. The design criteria are separated into specific disciplines including: hydraulic, biological, structural, electrical, and mechanical. Also considered in the evaluation of each alternative are system flexibility, ease of operation, construction cost, constructability, and safety criteria. Attachment A includes Pertinent Data for The Dalles Dam.

Figure 1 through Figure 3 display the overall layout of the east fish ladder and entrances.

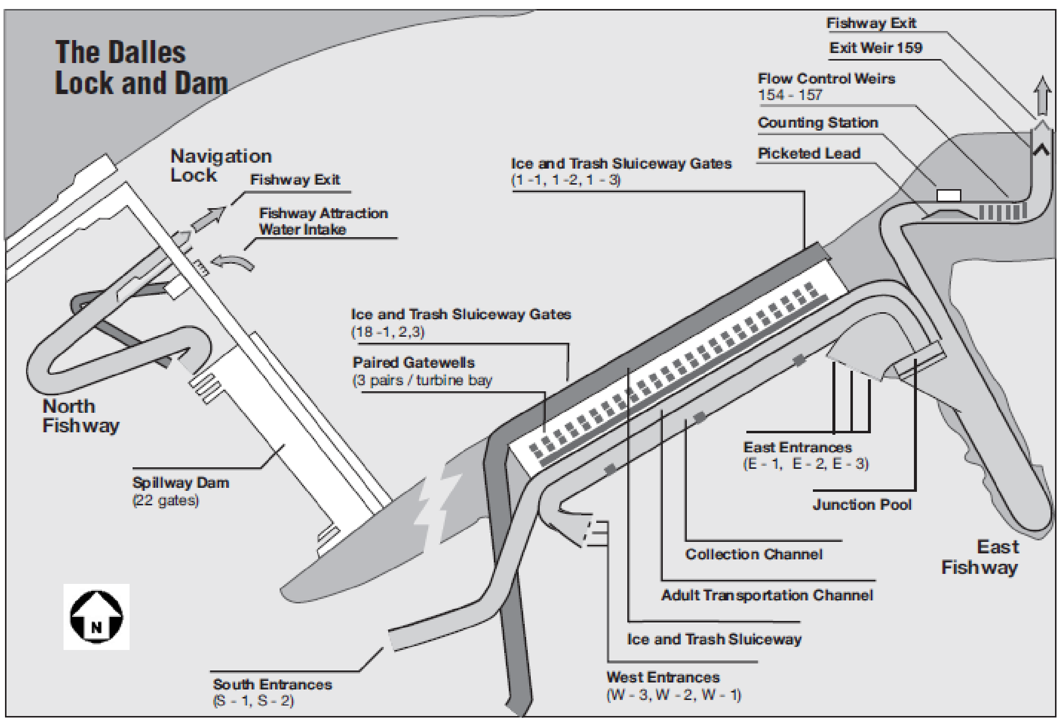

Figure 1. The Dalles Dam Fish Ladder System
(Illustration from the 2008 Fish Passage Plan, USACE)

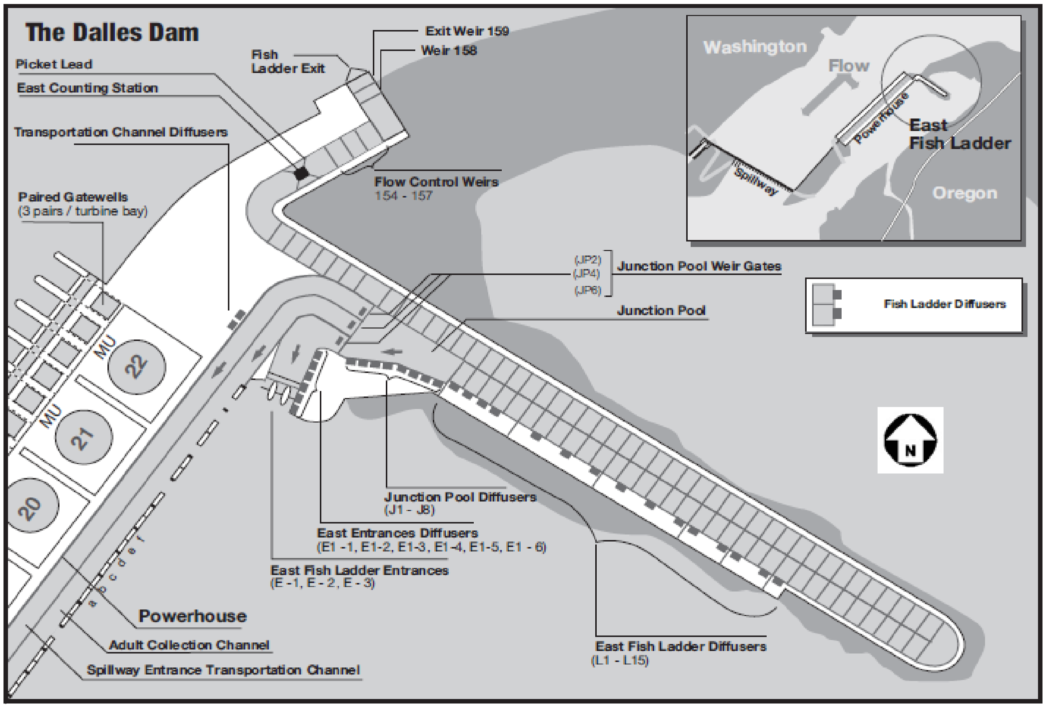

Figure 2. The Dalles Dam East Fish Ladder
(Illustration from the 2008 Fish Passage Plan, USACE)

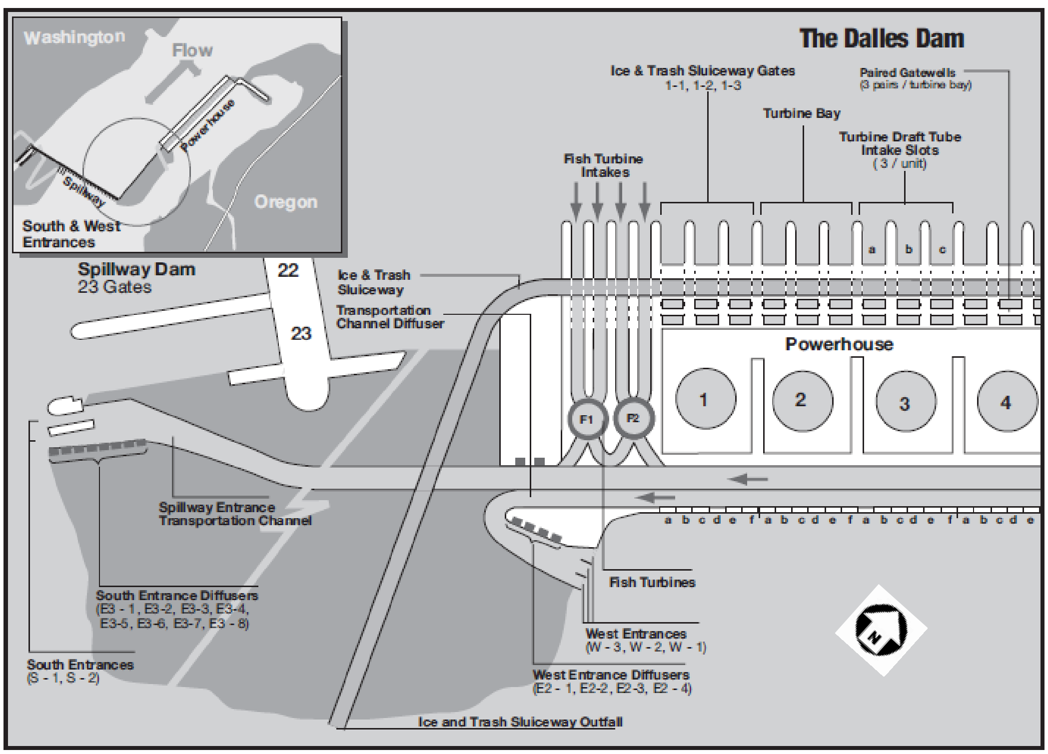

Figure 3. The Dalles Dam West and South Fish Ladders
(Illustration from the 2008 Fish Passage Plan, USACE)

1.3 Design Life

The alternatives considered in this project would have an estimated design life of 50 years.

1.4 Hydraulic Criteria

1.4.1 General

The hydraulic criteria list the discharges, water surface elevations, head differentials, and velocities used as the constraints in developing the concept designs for each alternative. Discharge and water surface elevation levels are divided into two types: maximum design and normal operating limits. The maximum design values are those used in designing the alternative and assessing the stability and forces acting upon it. The operating values are those for which the alternative is designed to operate and perform its intended purpose. The operating values may include both minimum and maximum values.

The selected alternative must be able to function under varied flow conditions. Flow requirements for optimal fish passage operations vary due to the fluctuation of forebay and tailwater conditions. The normal forebay elevation ranges from 155 to 160 feet (ft).

Due to the constant fluctuations in the forebay and tailwater elevations, operation of the turbine units and fishway entrance weirs is controlled automatically. As the tailwater and forebay elevations fluctuate, the turbine unit discharge and entrance weir elevations change to maintain a constant head differential at the fishway entrances. The following components are impacted by forebay and tailwater elevation fluctuations:

- Entrance weir elevations will fluctuate as the tailwater changes to meet the entrance head differential criterion.
- West and South fish entrance weirs will be closed.
- The East fish entrance will operate with two weirs; the third weir will be closed.
- Entrance weir elevation changes result in water surface elevation changes throughout the fishway channel system.
- Fish turbine operations change in response to forebay and fishway channel elevation fluctuations.

Under a normal two turbine operating condition, the AWS operates with flows of up to 5,000 cfs. In an emergency operating scenario where there is a one or two fish unit failure, the proposed back-up AWS design discharge is 1,400 cfs.

Table 1 provides a summary of the design discharges for the existing fish turbine units and the emergency backup system at The Dalles Dam

Table 1. Design Discharges for Existing Fish Turbine Units and Emergency Backup System at The Dalles Dam.

Fish Unit Turbine Discharge	
Maximum:	2,500 cfs per unit
Operating:	2,500 cfs (peak generating efficiency flow per unit)
Total Discharge:	5,000 cfs (combined two units)
New Emergency Auxiliary Water System	
Design Discharge:	1,400 cfs
Operating:	1,400 cfs

1.4.2 Water Surface Elevations

The normal operating and design water surface elevations for forebay and tailwater are shown in Table 2. The exact water surface elevations used for the design of each alternative are described in the appropriate sections of this memorandum.

Table 2: Water Surface Elevations for Hydraulic Design

	Normal Operating Elevations (feet)	Design Elevations (feet)
Maximum Forebay	160.0	160.0
Minimum Forebay	155.0	155.0
Maximum Tailwater	84.2	86.0
Minimum Tailwater	72.5	72.5

1.4.3 Head Differentials and Velocities for Fish Ladders

The following criteria, detailed in the 2009 Fish Passage Plan, are used for guidance in developing the AWS backup alternatives and for evaluation of the alternatives. The 2009 Fish Passage Plan was written by the USACE and adopted by regional agencies. This plan documents the operational procedures for ensuring fish passage (juvenile and adult) at USACE projects.

- Water depth over fish ladder weirs: 1.0 ft +/- 0.1 ft. During the shad passage season: 1.3 ft +/- 0.1 ft.
- Head on all entrance weirs: 1 ft to 2 ft (1.5 ft optimum).
- Fishway transport velocities: Maintain water velocities of 1.5 to 4 feet per second (fps; 2 fps optimum) for the full length of the powerhouse collection channel, entrance channels, and the fish ladder pools that are submerged by the tailwater.
- Main entrance weir depths: Weir crest 8 ft or more below tailwater.

1.4.4 Auxiliary Water Conduit

The one-dimensional hydraulic numerical model of The Dalles fish facilities may be used by USACE Portland District staff to determine if the alternatives under consideration for the backup water supply would adversely impact the operation of the EFL. The model output will provide velocities and water surface elevations throughout the auxiliary water conduit (AWC) and fish channels. The model output will be reviewed to determine if the flow distribution through the AWS and fishway system are acceptable. Although there is no criterion for AWC velocities, a maximum velocity of 10 fps will be applied to the conduits to minimize energy dissipation issues.

1.4.5 Siphon Criteria

Two of the options include a siphon to discharge flow from the forebay to the fish lock. The main issues with a siphon include pressures in the system and priming issues. The following siphon design criteria were developed to minimize these issues.

- Limit negative pressures in the design to –5 ft.
- Provide adequate siphon priming such as a mechanical system to remove air from the siphon or a pumping system to fill the siphon with water to remove the air.
- Provide adequate inlet submergence on the pipe. The minimum inlet submergence will be one siphon pipe diameter.

1.4.6 Fish Lock Channel Criteria

The fish lock channel will be evaluated as an option to discharge flow into the AWC from the forebay. The fish lock channel was originally designed to transport fish to the lock, and was previously utilized as an open channel system until the fish lock was abandoned as a passage option. Due to the location of the channel, the walls extend up to 105 ft mean sea level (msl); however, the design operating water surface elevation was around XX. Hydraulic analyses are required to determine if the fish lock could be operated with a high open channel water surface elevation (much higher than the design water surface elevation) or if the fish lock would need to be covered allowing for pressurization.

Structural analyses will be required to determine the load restrictions of the channel walls for both an open channel water surface elevation with a minimum of 1 ft of freeboard and a condition where the channel is pressurized.

1.5 Geotechnical Criteria

1.5.1 Surface and Subsurface Assumptions

- Subsurface assumptions are based on material presented by the USACE in Part IV, Closure and Non-overflow Dams, of Foundation Report of The Dalles Dam, May 1964.
- Bedrock under the Non-overflow Dams and Closure structure are shown to be Basalts of Columbia River Basalt Group. No other rock units are identified.

Overburden depths under the East Non-overflow structure were shallow and all overburden was removed from beneath the structure during construction.

1.5.2 Geotechnical Assumptions

- Bedrock materials will be sufficiently strong to support relatively heavy structures.
- The unconfined compressive strengths of the basalt range from 2,000 pounds per square inch (psi) to 37,000 psi and may be very difficult to bore. Rock quality designation (RQD) for the basalt is 100%, and the rock mass rating (RMR) will vary by rock unit from Class I to Class II.
- For the final design structures will be designed for no damage during the operational based earthquake (OBE), with a no collapse criteria for the maximum credible earthquake (MCE). Table 3 provides the seismic design criteria for The Dalles Dam.

Table 3: Seismic Hazard for USACE Performance Levels

Performance Level	Return Period	PGA (g)*
Operating Basis Earthquake (OBE)	144-year	0.10
Maximum Design Earthquake (MDE) (noncritical structures)	975-year	0.13
Maximum Credible Earthquake (MCE) (based on deterministic seismic hazard analysis [DSHA])	2,475-year	0.19

**PGA from U.S. Geological Survey (USGS) National Seismic Hazard Maps (NHSM), 2008*

1.5.3 Geotechnical Construction Assumptions

- The ability to use small diameter boring machines will be determined by the rock properties. The properties vary from good to difficult.
- In-water rock excavation or use of small diameter boring units should be avoided due to the high cost associated with this type of work.

1.5.4 Applicable USACE Design Documents

- EM 1110-1-2907, Rock Reinforcement, 15 Feb 1980
- EM 1110-1-2908, Rock Foundations, 30 Nov 1994
- EM 1110-2-2200, Gravity Dam Design, 30 June 1995
- ER 1110-2-1806, Earthquake Design and Evaluation of Civil Works Projects, 31 July 1995.

1.6 Biological Criteria

1.6.1 General

This section deals with biological and behavioral characteristics of both adult and juvenile fish species that migrate through The Dalles Dam fish passage facilities. Although this design criteria memo is focused on facilities for the fish ladders that convey adult migrants upstream, downstream migrants are also discussed as they are a consideration for potential entrainment in the design of the water intake structures. The criteria stated below deal with passage seasons and project operational criteria.

There are two main fish ladders at The Dalles Dam: the North and East Fishways. The East Fishway has three different entrances for upstream migrating fish. The South and West entrances direct fish into channels that pass along the downstream side of the powerhouse and join the East Fishway upstream of the east entrance at a junction pool.

Species of fish migrating upstream at The Dalles Dam include Chinook, coho, and sockeye salmon; steelhead trout; American shad; and Pacific lamprey. Occasionally bull trout and white sturgeon have been observed in the fish ladder. Upstream migrants are present at the dam year-round.

1.6.2 Adult Passage Period

Upstream migrants are present at The Dalles Dam throughout the year and adult passage facilities are operated year-round. Adult fish (salmon, steelhead, shad, and lamprey) are normally counted from April 1 through October 31. Peak numbers of upstream migrating salmon and steelhead occur in May through October.

1.6.3 Adult Passage Criteria

Adequate water depths and flows through the fishways are required to facilitate fish moving upstream through the ladders. The operating criteria for the adult fish passage facilities is listed in the 2009 Fish Passage Plan for The Dalles Dam (USACE, 2009). During the fish passage season, water depths in the fish ladder must be maintained at 1 foot for salmon passage, and 1.3 feet during peak shad passage. The fish ladder entrances must maintain a 1- to 2-foot head, and water velocities in the collection channels and lower ends of the fish ladders must be between 1.5 to 4 fps, with 2 fps being optimum.

The complete criteria for adult passage within the East, West, and South Fish Ladders are also set forth in the 2009 Fish Passage Plan for The Dalles Dam.

1.6.4 Juvenile Passage Period

Juvenile fish passage facilities at The Dalles Dam consist of the ice and trash sluiceway and one, 6-inch orifice in each gatewell. When any of the sluiceway gates (located in the forebay side of the sluiceway) are opened, water and juvenile migrants are skimmed from the forebay into the sluiceway and deposited in the tailrace downstream of the project. The primary juvenile fish passage period is April through November. Because juvenile monitoring is not performed at The Dalles Dam, refer to Table 4 (referenced from the

2009 Fish Passage Plan) and add approximately one day to the dates for each species to estimate the juvenile fish arrival at The Dalles Dam.

Table 4. Juvenile Fish Migration Dates for John Day Dam

Yearling Chinook				
	10%	50%	90%	# of Days
1999	22-Apr	13-May	31-May	40
2000	20-Apr	9-May	28-May	39
2001	6-May	27-May	20-Jun	46
2002	1-May	17-May	1-Jun	32
2003	3-May	19-May	2-Jun	31
2004	28-Apr	16-May	30-May	33
2005	25-Apr	12-May	22-May	28
2006	25-Apr	11-May	24-May	30
2007	2-May	13-May	25-May	24
MEDIAN	28-Apr	14-May	30-May	34
MIN	20-Apr	9-May	22-May	24
MAX	6-May	27-May	20-Jun	46

Subyearling Chinook				
	10%	50%	90%	# of Days
1999	18-Jun	29-Jun	25-Jul	38
2000	6-Jun	29-Jun	3-Aug	59
2001	27-Jun	30-Jul	22-Aug	57
2002	20-Jun	30-Jun	20-Jul	31
2003	6-Jun	27-Jun	30-Jul	55
2004	14-Jun	28-Jun	23-Jul	40
2005	19-Jun	5-Jul	27-Jul	39
2006	14-Jun	3-Jul	18-Jul	35
2007	25-Jun	8-Jul	17-Jul	23
MEDIAN	16-Jun	30-Jun	26-Jul	41
MIN	6-Jun	27-Jun	17-Jul	23
MAX	27-Jun	30-Jul	22-Aug	59

Unclipped Steelhead				
	10%	50%	90%	# of Days
1999	26-Apr	23-May	5-Jun	41
2000	18-Apr	5-May	28-May	41
2001	28-Apr	5-May	30-May	33
2002	19-Apr	19-May	8-Jun	51
2003	30-Apr	28-May	4-Jun	36
2004	30-Apr	23-May	2-Jun	34
2005	1-May	14-May	24-May	24
2006	24-Apr	13-May	29-May	36
2007	29-Apr	13-May	28-May	30
MEDIAN	27-Apr	13-May	29-May	33
MIN	18-Apr	5-May	24-May	24
MAX	1-May	28-May	8-Jun	51

Hatchery Steelhead				
	10%	50%	90%	# of Days
1999	29-Apr	28-May	7-Jun	40
2000	15-Apr	2-May	24-May	40
2001	2-May	17-May	10-Jun	40
2002	24-Apr	14-May	6-Jun	44
2003	2-May	29-May	4-Jun	34
2004	7-May	20-May	29-May	23
2005	4-May	19-May	26-May	23
2006	28-Apr	10-May	29-May	32
2007	4-May	12-May	26-May	23
MEDIAN	2-May	16-May	30-May	30
MIN	15-Apr	2-May	24-May	23
MAX	7-May	29-May	10-Jun	44

Table 4. Juvenile Fish Migration Dates for John Day Dam

Coho					Sockeye (Wild + Hatchery)				
	10%	50%	90%	# of Days		10%	50%	90%	# of Days
1999	30-Apr	22-May	2-Jun	34	1999	10-May	17-May	1-Jun	23
2000	5-May	13-May	8-Jun	35	2000	30-Apr	14-May	9-Jun	41
2001	17-May	1-Jun	14-Aug	90	2001	1-Jun	14-Jun	27-Jun	27
2002	7-May	1-Jun	12-Jun	37	2002	9-May	21-May	2-Jun	25
2003	9-May	30-May	8-Jun	31	2003	10-May	19-May	2-Jun	24
2004	12-May	27-May	12-Jun	32	2004	20-May	1-Jun	12-Jun	24
2005	5-May	16-May	3-Jun	30	2005	16-May	21-May	31-May	16
2006	10-May	26-May	12-Jun	27	2006	7-May	20-May	30-May	24
2007	5-May	16-May	4-Jun	31	2007	9-May	25-May	7-Jun	30
MEDIAN	8-May	24-May	6-Jun	31	MEDIAN	9-May	20-May	2-Jun	25
MIN	30-Apr	13-May	2-Jun	24	MIN	30-Apr	14-May	30-May	16
MAX	17-May	1-Jun	14-Aug	90	MAX	1-Jun	14-Jun	27-Jun	41

1.6.5 In-Water Work Period

The in-water work period for annual maintenance of fish facilities is scheduled from December 1 through February 28 (or 29). Work during this period minimizes the impacts on both upstream and downstream migrants. During the in-water work period, one fish ladder (North or East Fish Ladder) is always operational. Coordination with Northern Pasco Public Utility District (PUD) needs to take place prior to scheduling construction as they conduct routine maintenance each year during the weeks that the North Fish Ladder is out.

1.6.6 Fish Screening

As discussed with the USACE, fish screening will not be required (because of the temporary nature) to prevent juvenile and adult fish from entering the AWS.

During discussions with the USACE and National Oceanic and Atmospheric Administration (NOAA), fish intake screening for the AWS will not be required as it would only be operated under an emergency situation and operation would be temporary. Intakes placed deep within the forebay would also serve to minimize the potential for entrainment of downstream migrants, which typically inhabit the upper portion of the water column. However, trash racks with 1-inch horizontal spacing would be used on main units to keep debris from entering. Trash rack replacement will be considered for each alternative. The existing main powerhouse units have trash racks with 6-inch openings.

The four alternatives being considered for the AWS would be used temporarily during emergency measures, and therefore potential fish entrainment would only be a risk on a temporary basis. Placement of the intakes deep within the forebay would also preclude much of the need for screening since salmonid juveniles and adult downstream migrants and fall-backs inhabit the upper portion of the water column. As such, it was determined that fish screens will not be required for the four alternatives under consideration.

1.7 Structural Criteria

1.7.1 General

For conceptual design of structures considered in the study, structural analysis and general structural computations are required. One or more of the four (4) alternatives may involve penetrations through existing reinforced concrete sections. These penetrations must be analyzed to determine their effect on the structural integrity (and stability) of the facility. Drawings, calculations, and other structural support information can be found in a technical appendix that will support the EDR.

1.7.2 Design Code References

The following design code references, USACE Engineering Manuals (EM), and USACE Engineering Technical Letters (ETL) will apply:

- American Concrete Institute (ACI) 318-08 - Building Code Requirements for Structural Concrete
- American Institute of Steel Construction (AISC) Steel Construction Manual, 13th Edition
- AISC/ American National Standards Institute (ANSI) 360-05 – Specifications for Structural Steel Buildings
- EM 1110-2-2100 - Stability Analysis of Concrete Structures
- EM 1110-2-2104 - Strength Design for Reinforced-Concrete Hydraulic Structures
- EM 1110-2-2400 - Structural Design and Evaluation of Outlet Works
- EM 1110-2-2902 - Conduits Pipes and Culverts
- EM 1110-2-6053 - Earthquake Design and Evaluation of Concrete Hydraulic Structures
- ETL 1110-2-568 – Seismic Evaluation Procedures for Existing Civil Works Powerhouses
- International Building Code, 2009
- Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) 7-05

1.7.3 Structural Materials

The following structural design requirements and USACE ETLs will apply:

- Existing concrete 28-day compressive strength: f'c= 3,000 psi based on Appendix D evaluation procedures found in ETL 1110-2-568.
- New concrete 28-day compressive strength: f'c= 4,500 psi

- Existing reinforcing steel: Grade 40 fy = 40,000 psi based on Appendix D evaluation procedures found in ETL 1110-2-568
- New reinforcing steel: American Society for Testing and Materials (ASTM) A615, Grade 60 fy = 60,000 psi
- Existing structural steel: ASTM A36, fy = 36,000 psi or ASTM A572, fy = 50,000 psi
- New structural steel:
  - W shapes: ASTM A992, fy = 50,000 psi
  - M, S, C, MC, and L shapes: ASTM A36, fy = 36,000 psi
  - Hollow Structural Sections (HSS):
    - Round – ASTM A500 Grade B, fy = 42,000 psi
    - Rectangular and Square – ASTM A500 Grade B, fy = 46,000 psi
  - Pipe: ASTM A53 Gr, B, fy = 35,000 psi
  - HP shapes: ASTM A572 Gr. 50, fy = 50,000 psi
  - Plates and Bars: ASTM A36, fy = 36,000 psi
  - Conventional Structural Bolts: ASTM A325
    - Nuts: ASTM A563
    - Washers: ASTM F436
  - Anchor Rods: ASTM F1554 Gr. 36, fy = 36,000 psi, Gr. 55, fy = 55,000 psi

1.7.4 Design Loads and Operating Conditions

The alternatives will be evaluated to determine the effect and limitations of normal operating conditions of the main powerhouse unit and the EFL AWS. This evaluation will include dewatering and partial dewatering of the AWC, diffuser chambers, and draft tubes. Structural components will be evaluated for the range of anticipated operating pressures for the preferred alternative.

These apply to all alternatives unless otherwise noted.

- Maximum pool elevation: 160.0 ft
- Maximum tailwater elevation: 86.0 ft
- Minimum tailwater elevation: 72.5 ft

For extreme flood events, the maximum pool elevation will be 178.5 ft and maximum tailwater elevation will be 127.2 ft.

Additionally, a 2000 report by CH2M Hill/Montgomery Watson indicates that the AWC cannot be fully dewatered unless the elevation of the tailwater remains below elevation 70 feet msl for the duration of the dewatering.

1.8 Electrical Criteria

1.8.1 Station Service Power

The existing station service power system does not have available capacity allocated for any large additional loads that are not associated with the powerhouse. A new 13.8-kV tap with transformer and switchgear and motor control centers shall be included to provide power to large motor loads.

1.8.2 Induction Motors, 600-Volt and Less

Non-submersible motors would be in locations that are easily accessible for operation and maintenance. Enclosures for motors are to be totally enclosed, fan-cooled (TEFC) type. Service factors would be 1.15. Motor insulation would be Class F with the rise limited to Class B. Bearings are to be rated 100,000-hour Anti-Friction Bearing Manufacturers Association (AFBMA) B-10 life. Motor voltages would be 460-volt, 3-phase for motors 0.5 hp up to 200 hp, and 120-volt, single-phase for motors less than 0.5 hp. All 3-phase motors of 50 hp or less may be operated from combination motor starters with overload protection and 120-volt control transformers located in the motor control centers. All motors would have local disconnect switches at the equipment. The use of soft-start reduced-voltage starters or variable frequency drives (VFDs) may be required for pump starting with motors greater than 50 hp.

Depending on the cooling requirements for the pump motor, the use of totally enclosed, water-to-air cooled (TEWAC) motors may be required.

1.8.3 Induction Motor, Greater than 600 Volt

Enclosures for motors are to be cast iron type WP-1 or WP-II. Service factors would be 1.15. Motor windings shall be form wound. Insulation shall be Vacuum Pressure Impregnation (VPI) or Continuous Resin Flow Impregnation (CRFI). Bearing resistance temperature detectors (RTDs) and vibration monitors shall be included. Motor voltages would be 4,160-volt, 3-phase for motors. Motors would be operated from medium-voltage VFDs, and will not include local disconnects at the equipment.

1.8.4 Motor Operated Valve and Gate Actuators

The motor operated valve and gate actuators would be served with power from an existing motor control center located at the dam, which is related to the fishway system with 480-volt, 3-phase power. It is assumed the valves and gates would include motors in the range of 1 to 2 hp.

The control circuits for any remotely controlled valve or gate operators would be routed back to the main control room, located at the powerhouse. Valves and gates would include a local control station with LOCAL/OFF/AUTO selector switch and push-buttons for OPEN, CLOSE, and STOP operation.

1.8.5 Design Code References

The alternative designs would conform to the latest edition of the following applicable standards and codes:

- National Electrical Code (NEC-2011 edition)
- Life Safety Code (National Fire Protection Association [NFPA]-101 2009 edition)
- National Electric Safety Code (ANSI C2 2012 edition)
- Standard for Electrical Safety in the Workplace (NFPA 70E)
- American National Standards Association (ANSI)
- Illuminating Engineering Society (IES)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Instrument Society of America (ISA)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Administration (OSHA)
- Underwriters Laboratories (UL)
- InterNational Electrical Testing Association (NETA)

1.9 Mechanical Criteria

1.9.1 Pump Station and Pipelines

Listed below are the design criteria for the pump station and pipelines:

- Maximum hydraulic velocity for all piping systems: 16 feet per second
- Target hydraulic velocity: 5 to 8 fps
- Maximum velocity for pump suction pipes: 8 fps
- For the 1500 cfs (673,200 gallons per minute [gpm]) flow it may be necessary to use two pumps depending on the commercial availability of large vertical or concrete volute pump (CVP) pumping units.
- Two generic types of pumping units will be evaluated: vertical axial or mixed flow pumps and the CVP.
- The pump station will incorporate all of the support utilities necessary for the two types of pumping units to be evaluated.
- For conceptual design, the pump efficiency will be assumed to be 85 percent at the best efficiency point (BEP).
- Historical low tailwater elevation will control the net positive suction head requirements for the pumping unit(s).

- The possibility of using both floating and fixed pump station configuration will be evaluated. The floating alternative will be for only the vertical pump alternative because it is not practical to construct the CVP alternative in that configuration.
- For pricing, the use of bronze fitted impellers will be assumed.
- The pump driver will consist of an appropriately-sized electric motor operating at 900 revolutions per minute (rpm) close coupled to a parallel shaft gear reduction unit.
- For pump station layout, installation of a bridge crane for maintenance will be incorporated into the design.
- The design water surface elevations for the suction side of the pump station alternative will be the historical high and low tailwater elevations.

1.9.2 Design Code References

The designs of alternatives would conform to the following pertinent mechanical criteria and applicable standards and codes:

- American Water Works Association (AWWA)

1.9.2.1 Water Control Gates

- Conform to AWWA 561, Standard for Fabricated Stainless Steel Slide Gates
- Maximum effort on crank or handwheel: 40 pounds.
- Centerline height of crank or handwheel: 36 inches.
- Stem covers: Clear butyrate plastic with Mylar open/close indicator.
- Maximum allowable leakage rate: 0.1 gpm per foot of seat perimeter.

1.9.2.2 Piping

- AWWA C200, Standard for Steel Water Pipe–6 In. (150 mm) and Larger
- AWWA C206, Standard for Field Welding of Steel Water Pipe
- AWWA C207, Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 IN through 144 IN.
- AWWA C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- AWWA C210, Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

1.9.2.3 Valves

- AWWA C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
- AWWA C504, Rubber Seated Butterfly Valves
- AWWA C540, Standard for Power-Actuating Devices for Valves and Slide Gates

- AWWA C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

1.9.2.4 Pumps

- Pump hydraulics and design will comply with the requirements of the Hydraulic Institute Standards.

1.10 Construction Considerations

The ease of construction was considered with each alternative. The alternative that is more easily constructible is preferable when determining the final recommended alternative.

1.11 Operational Criteria

The ease of operation and maintenance was considered with each alternative. If an alternative was easier to operate compared to the other alternatives it was given a higher score compared to the others.

1.12 Cost

A conceptual level cost estimate for each investigated alternative will be prepared at the 60% level. Cost data will be based on estimates from vendors, fabricators, contractors, the Oregon Department of Transportation (ODOT) construction cost database, previously prepared cost estimates at The Dalles Lock and Dam Spillway, and other projects in the Pacific Northwest. The estimates will contain contractor markups and contingencies. Contingencies amounts will be established based on an Abbreviated Risk Analysis see guidance at www.nww.usace.army/mil/html/OFFICES/ED/C/default.asp. Cost estimates for the alternatives selected for the 90% and final reports will be a Micro Computer Aided Cost Estimating System Version II (MCASES II) estimate with contingencies being established based on an Abbreviated Risk Analysis. Cost estimates will conform to USACE publications Engineering Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works Projects; ER 1110-2-1302, Civil Works Cost Engineering; and ETL1110-2-573 Engineering and Design: Construction Cost Estimating Guide for Civil Works.

1.13 Safety Criteria

Safety was an important consideration when evaluating each alternative. If the construction or operation of an alternative put human life or existing structures at risk, the alternative was not considered. All regulatory safety standards were considered during the development of each alternative. The safety of construction and operation and maintenance personnel would be essential for each alternative.

Attachment A
Pertinent Data

PERTINENT PROJECT DATA THE DALLES LOCK AND DAM - LAKE CELILO		
GENERAL		
Location	Columbia River, Oregon and Washington, River Mile 192	
Drainage area	Square miles	237,000
RESERVOIR – LAKE CELILO		
Normal minimum pool elevation	Feet, msl	155
Normal maximum pool elevation	Feet , msl	160
Maximum pool elevation (PMF regulated, 2009)	Feet , msl	178.4
Minimum tailwater elevation	Feet, msl	72.5
Maximum tailwater elevation (PMF regulated, 2009)	Feet, msl	127.2
Reservoir length (to John Day Dam)	Miles	23.5
Reservoir surface area – normal maximum power pool (EL 160.0)	Acres	9,400
Storage capacity (EL. 160.0)	Acre-feet	332,500
Power drawdown pool (EL. 155)	Acre-feet	53,500
Length of shoreline at full pool (EL. 160.0)	Miles	55
FLOOD CONDITIONS		
Probable maximum flood (unregulated)	ft^3/s	2,660,000
Probable maximum flood (regulated)	ft^3/s	2,060,000
Standard project flood (unregulated)	ft^3/s	1,580,000
Standard project flood (regulated)	ft^3/s	840,000
100-year flood event (regulated)	ft^3/s	680,000
SPILLWAY		
Type	Gate-controlled Gravity Overflow	
Length	Feet	1,447
Elevation of crest	Feet, msl.	121
Number of gates		23
Height (apron to spillway deck)	Feet	130
NAVIGATION LOCK		
Type	Single Lift	
Lift – normal	Feet	87.5
Lift – maximum	Feet	90
Net clear length	Feet	650
Net clear width	Feet	86
Normal depth over upper sill	Feet	20

PERTINENT PROJECT DATA THE DALLES LOCK AND DAM - LAKE CELILO		
Minimum depth over upstream sill	Feet	15
Minimum depth over downstream sill	Feet	15
POWER PLANT		
Powerhouse type	Conventional (indoor)	
Powerhouse width	Feet	239
Powerhouse length	Feet	2,089
Number of Main Generating Units		*22*
Installed power capacity	Kilowatts	1,806,800
Peak generating efficiency flow	ft^3/s	260,000
Maximum flow capacity	ft^3/s	320,000
Fishway Units (Not Included Above)		*2*
Installed power capacity	Kilowatts	28,000
Peak generating efficiency flow	ft^3/s	2,500
Maximum flow capacity	ft^3/s	2,500
Station Service Units (Not Included Above)		*2*
Installed power capacity	Kilowatts	6,000
Peak generating efficiency flow	ft^3/s	300
Maximum flow capacity	ft^3/s	300
FISH FACILITIES		
Adult ladders		2
Ladder designations		North and East
North ladder width	Feet	24
East ladder width	Feet	30
Ladder slope (typical)		1v:16h
Ladder elevation change (typical)	Feet	84
WASCO COUNTY PUD POWER PLANT (OPERATING AT THE NORTH FISH LADDER AWS)		
Powerhouse type	Conventional (indoor)	
Powerhouse width	Feet	44
Powerhouse length	Feet	48
Intake Structure width	Feet	25
Intake Structure length	Feet	125
Number of Main Generating Units		*1*
Installed power capacity	Kilowatts	5,000
Peak generating efficiency flow	ft^3/s	800
Maximum flow capacity	ft^3/s	800